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ON NEW CALIFORNIAN PULMONATA, ETC.

BY J. G. COOPER, M.D.

ALEXIA SETIFER. Cp. n. s. Pl. 3, fig. A. 1 to 6.

SP. CH. *Alexia* "*A. myosotis*" persimilis, sed testâ juniore ætis brevissimis deciduis munitâ, lineâ spirali ante sutura sitis. Var. *tenuis*, elongata, pallida.

Lat. 0.08 ad 0.14, alt. 0.30 ad 0.40 partes cent. pollici.

Shell very similar to *A. myosotis* (of the northern Atlantic States), but the young provided with short deciduous bristles, arranged in a spiral line just in front of the suture.

Form varying from ovate to lanceolate, translucent, smooth, pale to dark corneous, with a purple tinge, often marked with numerous longitudinal paler stripes; apex short, or rather lengthened and subacute; suture usually distinct, whorls six or seven, the nuclear three or four, very narrow, and nearly alike, with the apex inverted or planorvoid; the last elliptic-ovate, and forming nearly three-fourths of the total length; aperture nearly two-thirds of total length; peristome thickened and projecting horizontally, especially in front, appressed to columella, leaving a slight umbilical fissure open, then blending with a strong plait which winds obliquely inward; parietal wall with a white transverse flat denticle near its middle, and usually a small tubercle above it, making the mouth three-toothed on the inner side.

Young shell showing the bristles on about three whorls, the first two or three being without them, and losing them by wearing off after attaining half its growth.

The variety *tenuis* is slender, elongated, shell usually thinner and paler, sometimes amber-yellow. Many of the more robust form are, however, fully as thin and pale.

Animal yellowish-white, translucent; eyes black; tentacles transparent, faintly wrinkled, muzzle strongly wrinkled transversely.

This species seems chiefly characterized by the bristles of the young shell, but these may exist in some other species, being easily overlooked, or rubbed off in cleaning the shell, which is often covered with adhesive mud.

The usual form of the adult differs much from the figure given by Binney of "*A. myosotis*," more resembling other European

species. The variety *tenuis*, however, is very similar to that of Binney and Tryon. The figures show the varieties of form and color met with here, but scarcely two specimens are exactly alike, and some adult shells are as ventricose as the young one figured.

I found this species exceedingly numerous on the stony shore of a tide-water creek within the limits of San Francisco, but only for a distance of about ten rods, where a rocky point comes to the shore, though a few can be found for half a mile on loose stones and timbers, crawling under the stones in great numbers when the tide is out long. They look so similar to the buds of the *Salicornia* which grows about the spot that they may easily be overlooked by enemies when crawling among it. They creep rather rapidly by a steady gliding motion, like the other pulmonates, and live for a week or more in a damp vial, though killed quickly by immersion in fresh water.

Though so numerous that several hundred may be scraped off from the bottom of a small stone, it is strange that this shell has escaped the notice of a host of collectors for more than twenty years, though many of them must have passed within a few yards of the spot, as it is close to the old southern entrance to the city by land. This suggests that it may have been introduced from China on the bottoms of fishing-boats, or as ova in damp nets or otherwise, especially as the Chinese have always made the creek a fishing station, and cultivate the low land along its shores. It is, however, just as likely to be native, and to have been overlooked on account of the limited and rather inaccessible locality it inhabits. Until it is proved that these delicate aquatic mollusca *can* be transported from one country to another by the ways of commerce, it is better to consider them indigenous. I may be able to find them in other similar localities out of the way of foreign vessels.

It is almost as probable that the *Assiminea*, which is equally numerous in the same spot, was introduced in the same way, though that is probably the same as found in other similar creeks about the bay.¹

¹ Note on "*A. myosotis*" of U. S. Atlantic Coast. The variations of the Pacific shell suggest that the form figured by Binney is only the northern attenuated form of what may occur farther south more fully developed as "*Leuconia*" *Sayii* (Kuster sp.), which, according to Jay's catalogue, is found in New Jersey. Conrad's and De Kay's descriptions of "*borealis*"

I will probably be able to make explorations sufficient to determine most of these doubtful points relating to this and many other species, before the publication of the Conchology of California by the Geological Survey.

LIMAX (AMALIA) HEWSTONI. Cp. n. s. Pl. 3, Fig. B. 1 to 5.

SP. CH. *Limax* "*L. Sowerbii*" similis, dorso postice valde carinato et altiore; clypeo granulatim rugoso, et sulco subelliptico super spiraculo submediano; colore ex brunneo nigrescens vel supra nigerrima, lateribus pallidioribus, disco motivo infra albescens.

Long. circa duo polliceo, alt. corporis bis major quam lat. disci motivi. Testa oblongo-ovalis, $\frac{1}{3}$ poll.

Similar to *L. Sowerbii* (of England), the back being strongly carinate even when fully extended, and higher than the front of body; shield granulate-rugose, and with a groove, sub-elliptic in outline, above the level of the spiracle, which is just behind the middle; color blackish-brown, or deep black above, the sides paler, the locomotive disk beneath whitish.

Length about two inches or less, height of body twice the width of foot. Shell oblong-oval, $\frac{1}{5}$ inch long. Its other characters agree with those common to most of the subgenera *Amalia* and *Eulimax*. The figures best show the comparative points.

I have named this species in compliment to Dr. George Hewston, of this city, who has made many interesting observations on the habits of the species in his garden.

It is, I believe, the first "*Amalia*" found in the United States, native or naturalized. In the remarkable groove on the shield it differs from any I find described, but, as this is not apparently connected with any organic difference, it seems merely a specific

indicate varieties like ours but not described by Binney, while Say's "*turritus*" is like the young.

Binney's figure of the animal of "*Tralia*," from Charleston, is so much like ours, that it seems probable that it may also be a more southern development of the *Alexia*, while his "*T. pusilla*," from Florida, looks very like some forms of our *A. setifer*, the revolving lines and labial denticles being, perhaps, more perfect characteristics not found far north. *Melampus bidentatus* presents similar variations with a like geographical range. Eastern conchologists may decide whether it is not more likely that the southern shell extends north under a less perfect form, than that the northern shell has come from Europe, and also which of the names quoted is prior, if it is distinguished from the latter.

character. It does not even coincide with the outline of the attached portion, or with the shell, and, though general, is in some so faint as to be scarcely visible.

The *L. fuliginosus*, Gld., seems very similar, and might pass for the same, though described as from "New Zealand," but has ferruginous tentacles.

It is barely possible that this species was introduced from China or elsewhere, as I have not met with it beyond the vicinity of San Francisco, but it is so exceedingly numerous in every garden here that it seems indigenous. It is found in drier places than our others, and is active all summer in moist shady places. I find none like it described from Asia or Europe.

LIMAX (EULIMAX) CAMPESTRIS, Binney.

Var. OCCIDENTALIS. Pl. 3, fig. C. 1 to 5.

This, the only indigenous eastern species, has not been before announced from west of the Rocky Mountains, and I, therefore, give a figure of the California form which appears rather more robust than the eastern. It presents the same range of colors, from amber-brown to black, being paler when it first emerges from its retreat in the dry season. I have found it numerous at San Francisco and Santa Cruz, at Clear Lake, Alta, 3625 ft. elev. on west slope of the Sierra Nevada, and Truckee, 5866 ft. high on the east slope, besides observing probably the same at points near lats. 37° and 39° in the valleys. It has not been noticed in Oregon.

ARIOLIMAX CALIFORNICUS. Cp. n. s. ? Pl. 3, fig. D. 1, 2, 3.

SP. CH. *A. forma*, colore, etc. "*A. Columbiano*" similis, sed sulcis dorsalibus multo frequentioribus; sæpe bis numero, et transversé reticulatis.

Resembling *A. Columbianus* in form and color, but with the dorsal grooves much more numerous (26 to 36), often twice as many, and the connecting reticulations transverse.

The figures given of portions of this form, taken from life, show the remarkable dissimilarity in the reticulations of the dorsal region, and, did I not find considerable variation among them, I would consider it certainly a different species.

The black form next mentioned agrees with the Oregon animal in this character as shown in E. Young and adult of the yellow form, from one to six inches long, all show the same peculiarity,

and it may be only an adaptation to a drier climate. It is quite well shown even in alcoholic specimens, and I am surprised that it has not before been mentioned. Some parts of Mr. W. G. Binney's description may, however, be taken from this variety. The following notes have not before been published, and are all taken from the southern form. Mr. Voy has brought it from the Sierra Nevada, lat. 39°, alt. about 3500 feet, but I have not heard of it elsewhere out of the coast range.

The locomotive disk, anal and generative orifices are like those of *Limax*. Fig. D, 3, shows the latter as preserved in alcohol in a specimen taken *in copulo*. I may be able to describe them more fully from fresh ones. The mantle is minutely granulated, which may have led Mr. Tryon to place it in *Amalia*. The dorsal-grooves are unicolor with the rest of body, but those of the upper margin of foot are colored brown (sometimes very pale), the color permanent in alcohol, and the stripes wider at every fourth or fifth, like the grooves. The longitudinal division of the foot beneath is very faintly perceptible.

The young, just hatched, is pale-yellowish, with pellucid whitish spots, and when an inch and a half long is colored like adult, while the shell is perceptible through the thin shield. This can also be seen by looking into the grisacle of the adult when fully expanded.

Eggs are laid from April 1st to June, and vary in size from 0.44×0.36 to 0.35×0.26 inch. (probably laid by slugs of various ages). They have a shelly but tough envelope, and, after they are laid, the shell is *often entirely wanting* in the animal, having apparently been absorbed to form the egg-shells! This may explain the absence or fragmentary state of the shell in some species referred to *Arion*.

ARIOLIMAX NIGER. Cp. n. s. Pl. 3, fig. E. 1, 2, 3, 4.

SP. CH. A. forma, testa, et maxilla "*A. Columbiano*" per similio, sed minor, robustior, colore nigro, tentaculis et disco motivo infra pallidioribus, maxilla costulis circa xx, dorso non carinato.

Long. ii. et dim. poll. (65 millimetres.)

In form, shell and jaw, it resembles *A. Columbianus*, but is smaller, back rounder, more robust, black, with tentacles and locomotive disk beneath paler, its jaw with only about 20 riblets. Length $2\frac{1}{2}$ inches.

Dr. Gould mentions a "small specimen uniformly slate color" (probably from alcohol), which indicates that this is also found in Oregon. A very young one from east of S. F. Bay has the shield and back brownish with small irregular black spots, and no carination perceptible as it is in the yellow species, which shows it stronger in the young than the adult. The dorsal grooves agreeing with those of the Oregon form suggested that it was only a southern dwarfed variety of that, which is often mottled with blackish; but Dr. Gould's specimen was also small, and may indeed have been collected in California. Here I find none intermediate between this and the yellow variety. The color and dorsal grooves agreeing with *Limax Hewstoni* also suggested hybridity, but I have never found this in the same localities with that species. We thus have three very distinct species often equally black, but the only common cause I can guess for this similarity is possibly more nocturnal habits than in the others. The comparative rarity of this form may be a consequence of more thorough concealment in the daytime. I found them copulating in December, and the young was found in February probably recently hatched.

ARION? ANDERSONII. Cp. n. s. Pl. 3, fig. F. 1, 2, 3, 4, 5.

SP. CH. A, "*Arioni foliato*" similis, sed multo minor, spiraculo prope medio clypei forte granulato rugosi, testâ internâ validâ; cauda acuta. Foramen generativum ut in *Ariolimax* et *Limax Hewstoni* situm.

Long. ii. et dim. poll.; lat. dioci motivi plus quam dimidium alt. corporis.

Similar to "*Arion foliolatus*," but much smaller, the spiracle close to middle of shield, which is strongly granulæ-rugose; a strong internal shell; tail acute. Length two and a half inches; breadth of locomotive disk more than half the height of body. Form slender, gradually tapering from the shield backwards to an acute point; shield large, covering one-third of back, distinctly granular, the spiracle not perceptibly anterior to middle, except when the animal is fully extended; upper tentacles little over one-fifth of the length of mantle, which is free in front nearly as far back as the spiracle, and a narrow edge free behind; dorsal furrows about 18, distinctly darker colored; foot slightly projecting at sides, the lateral bands distinctly separated beneath and marked by muscular fibres running obliquely backward and outward on the under surface.

Color. Reddish-gray, the body somewhat clouded with black, the shield paler, clouded, or more usually with a dark band on each side above the spiracle, converging in an elliptic form; a pale dorsal streak. Head uniform pale-brown, tentacles darker. Foot and often the mantle tinged with olive.

Shell large and thick, the nucleus near posterior left corner obtusely rhomboidal, concave beneath. Length about 0.14, breadth 0.06 inch.¹ Jaw arcuate, wider near middle, with 20 to 30 riblets denticulating the lower margin.

Hab. Near south and east sides of San Francisco Bay northward to Santa Cruz. It is confined to well wooded hills or damp river-banks, being less able to bear heat and dryness than our other slugs. I have named it for Dr. C. L. Anderson of the latter place, a zealous naturalist, who has much aided me by collecting this and other species of mollusca.

This species combines the form and spiracle of *Arion* with the shell and jaw of *Ariolimax*, making the generic distinctness of the two forms doubtful, and consequently connecting *Arion* still more closely with *Limax*. The minute caudal mucous gland and acute tail of this species also approach the character of *Limax*, and make the modern separation of these genera into separate families still more unnatural.

The rule adopted by Agassiz of founding family divisions on modifications of the general forms, and *genera* only on those of special organs, will apply well in the case of these animals. But a difficulty arises here in the disagreement of this species in several points from the latest definition of the genus *Arion*, in those characters above indicated as connecting it with *Ariolimax*. Still, as *Arion* is the older genus, it would seem more proper to extend its generic limits to include a more developed shell and jaw than usual, than to make *Ariolimax* include a species as different from the type in form, position of spiracle, and structure of locomotive disk. The form of the caudal termination seems like that of *Arion hortensis*. Orifice of generative organs about half-way between tentacle and shield as in *Limax*, etc.

In colors, this species is so similar to "*A. foliolatus*," Gld., that

¹ The shell represented in the figures is from a larger specimen than the animal figure.

it might be considered identical if not for the important differences indicated in the diagnosis.

Mr. Binney places that species without hesitation in subgenus *Lochea*, which has the shell represented by calcareous granules only, but remarks that he had not examined the jaw or granules, and, as the types are probably still preserved in the Smithsonian Institution, this important omission may yet be attended to.

Dr. Gould says, in Binney's Terr. Moll. ii. p. 31, "That this animal belongs to the genus *Arion* there can be little doubt, from the peculiar structure of the tail, as represented in Mr. Drayton's figure, and from the anterior position of the respiratory orifice." He did not examine any specimens with reference to the shell, but figures the dorsal areolæ as peculiarly granulated and indented, an appearance apparently caused, as in our species, when in alcohol, by minute reticular subdivisions. The figure represents the tail as acute, though Dr. Gould describes it as "somewhat truncated at tips exhibiting a conspicuous pit which was *probably* occupied by a mucous gland." As he was not aware of the existence of this gland in his "*Limax*" *Columbianus*, he may have examined specimens of the latter when partly or wholly destitute of the shell (as described by me), and confounded them with Drayton's figure, as alcoholic specimens do not retain all the specific characters. The great similarity of the figure published as of the *Arion* to that of *L. Columbianus* makes it probable that some such confusion has occurred, the only essential difference being the position of the spiracle.

Mr. Tryon places this species in *Ariolimax*, but on what grounds is not stated. This would be justified by the discovery of the shell and generative orifice in alcoholic specimens, but is rendered doubtful by other considerations above pointed out.

Mr. Drayton's *original* figure probably represented *A. Andersonii*, though Dr. Gould's description does not agree wholly with it.

LISINOE DIABLOENSIS. Cp. n. s. Pl. 3, fig. G. 1, 2, 3, 4.

Helix (indet., near *Traskii*), Cp., Proc. Cal. Acad. Sc. III. 260, 1866; 332, 1867 (as perhaps a hybrid).

H. Diabloensis, Cp., Amer. Journ. Conch. IV. 221, 1868.

Arionta? *Diabloensis*, Cp., ibid. V. 205, 207, 1870.

SP. CH. Testa depresso-turbinata, infra paullo concava, anfr. vi et dim. ad vii. umbilico amplo, peristomate albo, expanso, satis incrassato, superne declino; colore ex luteo brunnea, intus purpurascens, zonâ fusco-

brunneâ supra peripheriam, luteo, infra marginatâ, aufr. tribus visâ, regio inferior pallidior; epidermide nitente, tenuissime malleata rugosa, lineæ incrementi sulcis tenuibus sæpe obliquè insculptis; rugæ obscuræ circum umbilicum volventes. Testa junior non subangulata.

Diam. maj. 0.75 ad 0.95; min. 0.65 ad 0.80; alt. 0.40 ad 0.55; axis spiræ 0.30 ad 0.45 cent. poll.

Animal pallide griseo-purpurascens, corpore semicylindrico, bis lat. testæ æquans longitudine, tota superficies tuberculis parvis ellipticis induta; tentaculæ oculiferæ tertiam partem long. corporis æquantes; pes postice brevis, cuneatus, alt. corporis latior, margine crenato-incisâ. Per testâ visiente, partes molles nigræ perspicuæ sunt.

Hab. Montibus "Diablo" Californiæ prope San Francisco, altitudine circum 2500 ped. supra mare, inter sylvis quercinis et cypressinis, et prope "San Luis Obispo."

Shell depressed-turbinate, below a little concave, whorls $6\frac{1}{2}$ to 7, umbilicus large, peristome white, expanded, somewhat thickened, above descending; color yellowish-brown, paler beneath, with a dark-brown zone above the periphery, margined below by yellowish, visible on three whorls; epidermis shining, finely rugose-malleate, lines of growth often obliquely cut by delicate grooves, obscure revolving ridges around umbilical region. Young shell not subangled.

Animal pale purplish-gray, semicylindrical, its length twice the breadth of shell, its whole surface covered with small elliptic tubercles; eye-bearing tentacles one-third the length of body; foot short behind, wedge-shaped, broader than height of body, its margin crenately incised. Intestines seen through upper whorls.

Hab. "Cedar Mountain," 25 miles southeast of Mount Diablo, California, among oaks and cypresses, thence south to San Luis Obispo, 200 miles.

The first specimen obtained by Prof. Brewer, "east of Mount Diablo," was too imperfect for me to decide on its characteristics, and the sculpture, somewhat resembling that of the *Arionta* group, led me to refer it doubtfully to that, while the form and color suggested hybridity between *A. ramentosa* and the nearest of the *Lysinoë* groups, either *L. mormonum* or *Traskii*, neither of which were known, however, to exist within 90 miles of *ramentosa*. Fresh specimens, lately discovered by the industrious Dr. Yates, among the cypresses of Cedar Mountain, though much smaller,

indicate its near alliance with *L. Traskii*, differing as much, however, as several others of the allied species.

Specimens said to come from San Luis Obispo appear to be the same, and are the ones referred to by me in the Cal. Acad. Proc. III.332, as combining characters of *ramentosa* and *Dupetithouarsi*. I am, however, becoming more and more of the opinion that natural hybrids are so very scarce that shells presenting intermediate characters are to be considered rather *varieties* in which local proximity and exposure to the same influences produce changes simulating those of neighboring geographical groups, as before remarked, concerning some of our most northern and southern forms. Thus we have in this the nearest approach to the sculpture of the *Ariontas* to be found in our *Lysinoes*, as it exists on a belt next adjoining the centre of development of the sculptured group. *L. Dupetithouarsi* often shows a little of the same sculpture.

This form probably occupies the whole of the gap of 160 miles south of Mount Diablo, mentioned previously by me as destitute of any known species, but at an elevation seldom visited by collectors, though the young specimens, also found by Dr. Yates, "at the crossing of the Salinas River above Soledad," indicate that it, like others, may follow down the river banks into the valleys. These have a smaller umbilicus and flatter apex. About two hundred miles southward, the Mount Diablo range combines with the coast range near San Luis Obispo, the Salinas Valley lying between them.

GENUS ASSIMINEA, LEACH.

Although not a pulmonate mollusc, the species to be described forms a link between these and the branchiate shells, in its power of existing for several days, and even of crawling actively about in a slightly damp bottle, showing nearly as much vitality out of water as the *Alexia* with which it lives, while it cannot exist in fresh water. It is probable that, like *Ampullaria*, etc., it possesses a reservoir for moistening its gills, or a sort of imperfect lung. Its subterminal tentacular eyes are also similar to those of the *Pupillæ*, with only one pair of tentacles.

It will be lucky if some hair-splitting microscopist, ambitious of affixing his name to the species of others, does not find a slight difference in the lingual asperities on which to found a "new

genus," although the genus is now admitted to extend from England to India.

ASSIMINEA CALIFORNICA. n. s.? Pl. 3, Fig. H. 1, 2, 3.

? *Hydrobia Californica*, Tryon, Amer. Journ. of Conch. I. 221, pl. 22, f. 11.

SP. CH. A. testâ parvâ, imperforatâ, nitente, sutura bene impressa anfr. vi. convexis, cito crescentibus, ult. tumido; peristomate acuto, non continuo, callo tenui parietali; colore corneo, ex nigro-brunnescente, operculo pertenui, translucente, aufr. ii. et dim.

Long. 0.14, lat. 0.07, long. spiræ 0.025, aperturæ 0.06, div. 50°.

Animal albescens, tentaculis et caput antice nigro tincto, regio inter tentaculis rufus. Longitudo bis major quam long. testæ.

Habitat. In ripas aquarum salinarum extrinsii San Francisco, Californiæ, inter lapidas, *Salicornia*, etc.

Shell very small, imperforate, shining, whorls 6, rapidly increasing, rather convex, suture well impressed, body-whorl swollen, peristome not continuous, acute, with a slight parietal callus. Color dark horn-brown. Operculum very thin, colorless, its whorls $2\frac{1}{2}$. Animal whitish, tentacles and muzzle tinged with black, a rufous patch on top of head. When extended it is about twice as long as shell, the foot ovate.

Inhabits brackish creeks near mouth of San Francisco Bay, and found in great numbers within the city limits under small stones with *Alexia*. The animal crawls actively by a jerking motion, alternately projecting the foot in front of the muzzle and then drawing the shell forward, so as to show the two positions represented in the plate.

The shell closely resembles *Hydrobia Californica*, which is found in similar places at Oakland and Martinez, but, it being rather scarce there, I have not been able to obtain living specimens yet for comparison. Mr. Tryon's description and the dimensions given agree exactly, but Oakland specimens of the shell are thicker, the whorls a little shouldered, and the umbilical region pitted, perhaps from stronger growth. Mr. Tryon's figure, however, does not agree with the dimensions.

It differs from *A.?* *subrotundata*, Carpenter, of the Str. of Fuca, in all its dimensions and in size. (See Ann. and Mag. Nat. Hist., 1865, p. 28.) Several of our *fresh-water Hydrobrinæ* have been confounded with *H. Californica*.

I believe this is the first of the genus *determined* to inhabit the

United States, as Carpenter's was without the animal, and the genus is only mentioned in one Atlantic coast list, as probably found on Long Island, N. Y., by Sanderson Smith, in the Annals N. Y. Lyc. Nat. Hist. 1870, though it is suspected that some of the New England "*Rissoids*" are congeneric.¹

I have used the specific name *Californica* as not likely to lead to any confusion, even if Mr. Tryon's species proves to be a true *Hydrobid*, and thus of another family.

EXPLANATION OF THE PLATE.

A. *Alexia setifer*. 1, 2. The animals crawling, with shells of different forms and color. 3. Most usual form of the shell, showing the stripes often observed. 4. Var. *tenuis*, an extreme form. 5. Young, without upper tooth, a form of the shell occasionally found in the adult. 6. Young of very thin variety, showing revolving line of setæ.

B. *Limax Hewstoni*. Natural size. 2. Caudal extremity. 3. Shell. 4. Jaw magnified. 5. Shield from above showing groove, and generative organ anterior to it.

C. *Limax campestris*, var. 2, 3, 4, as in B.

D. *Ariolimax* var. *Californicus*. Natural size of parts. 1. Lateral view of furrows behind shield. 2. Caudal extremity, showing furrows, mucous pore and color of foot. 3. Anterior parts from alcohol, showing generative organs.

E. *Ariolimax niger*. Natural size. 2, 3, 4, as in B.

F. *Arion Andersonii*. Natural size. 2, 3, 4, as in B. 5. Lower surface of locomotive disk, from life.

G. *Lysinoe Diabloensis*. 2. Style of sculpture above. 3. Shell from beneath. 4. Front view of shell. 5. Lower surface of locomotive disk, showing crenations.

H. *Assimineæ Californica*, magnified. 2, 3, as in A.

¹ Mr. Smith's name "*Cæcum Cooperi*," being pre-occupied for a different Californian species, I may here return the compliment he offers to the memory of my father by naming it *CÆCUM SMITHII*, Cooper.